



College of Engineering

UNIQUE PROMISES AND CHALLENGES OF ALGAE



Kimberly Ogden, Professor & Chair

Chemical and Environmental Engineering



SAF Target = 35 billion gallons

- ~ 5 Billion from Waste
- Third Generation Biofuels
- Need to minimize cost, GHGs and land use change
- Difficult to meet the challenge without algae due to land use



PROJECT PARTNERS



Kelly Banta



Jack Smith



John Field



B&D Consulting



Jason Quinn



Steve Simske



Braden Limb



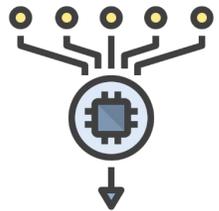
Ece Ari Akdemir



Jordan Kern

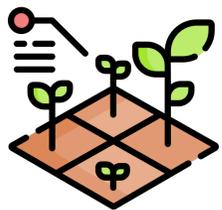
200M RESOLUTION GIS BIOMASS MODEL

Goal: Determine the land availability and total biomass that can be grown for bioenergy



County-level Outputs

- Land area by land cover
- Crop yield by land cover
- Total biomass grown
- Total biofuel produced
- Mean MFSP
- Mean gCO₂eq/gal



Land Exclusions

- Protected areas
- Key Biodiversity Areas
- Steep land grades
- Low crop yields (>\$20/gal)

NLCD Land Cover Type	Switchgrass	Miscanthus	Poplar	Algae
Water	No	No	No	No
Perennial Ice/Snow	No	No	No	No
Developed Land	No	No	No	No
Barren Land	No	No	No	Yes
Deciduous Forest	Yes	Yes	Yes	Yes
Evergreen Forest	Yes	Yes	Yes	Yes
Mixed Forest	Yes	Yes	Yes	Yes
Shrubland	Yes	Yes	Yes	Yes
Grassland/Herbaceous	Yes	Yes	Yes	Yes
Pasture/Hay	Yes	Yes	Yes	Yes
Cultivated Crops	Yes	Yes	Yes	Yes
Wetlands	No	No	No	No
Viable Slope	5%	5%	25%	2%
Minimum Yield (Mg/ha)	2.3	2.0	2.4	0.0

30.00 bn gallons

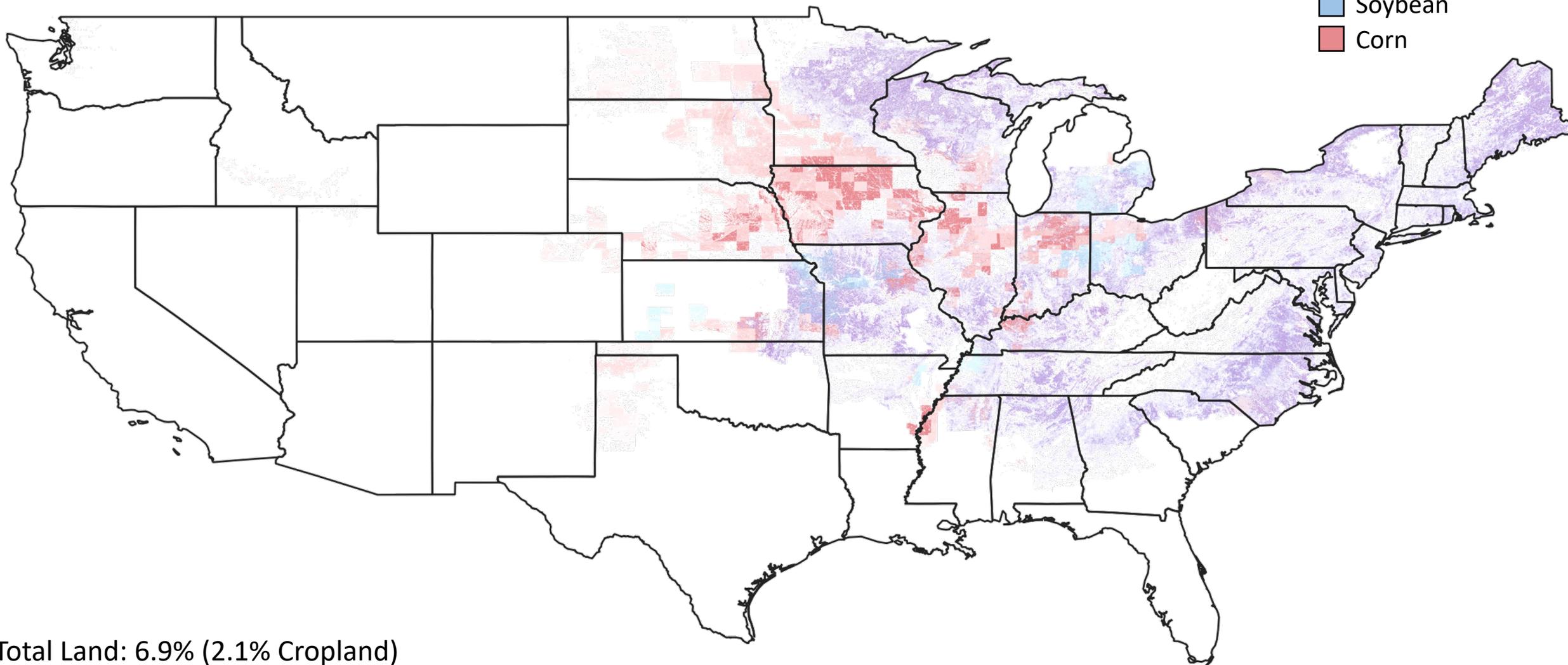
5,677 gCO₂/gal

\$4.20/gal

233.4 gal/acre

MINIMIZE MFSP (MINIMUM FUEL SELLING PRICE)

- Algae
- Miscanthus
- Poplar
- Upland Switchgrass
- Lowland Switchgrass
- Soybean
- Corn



Total Land: 6.9% (2.1% Cropland)

30.07 bn gallons

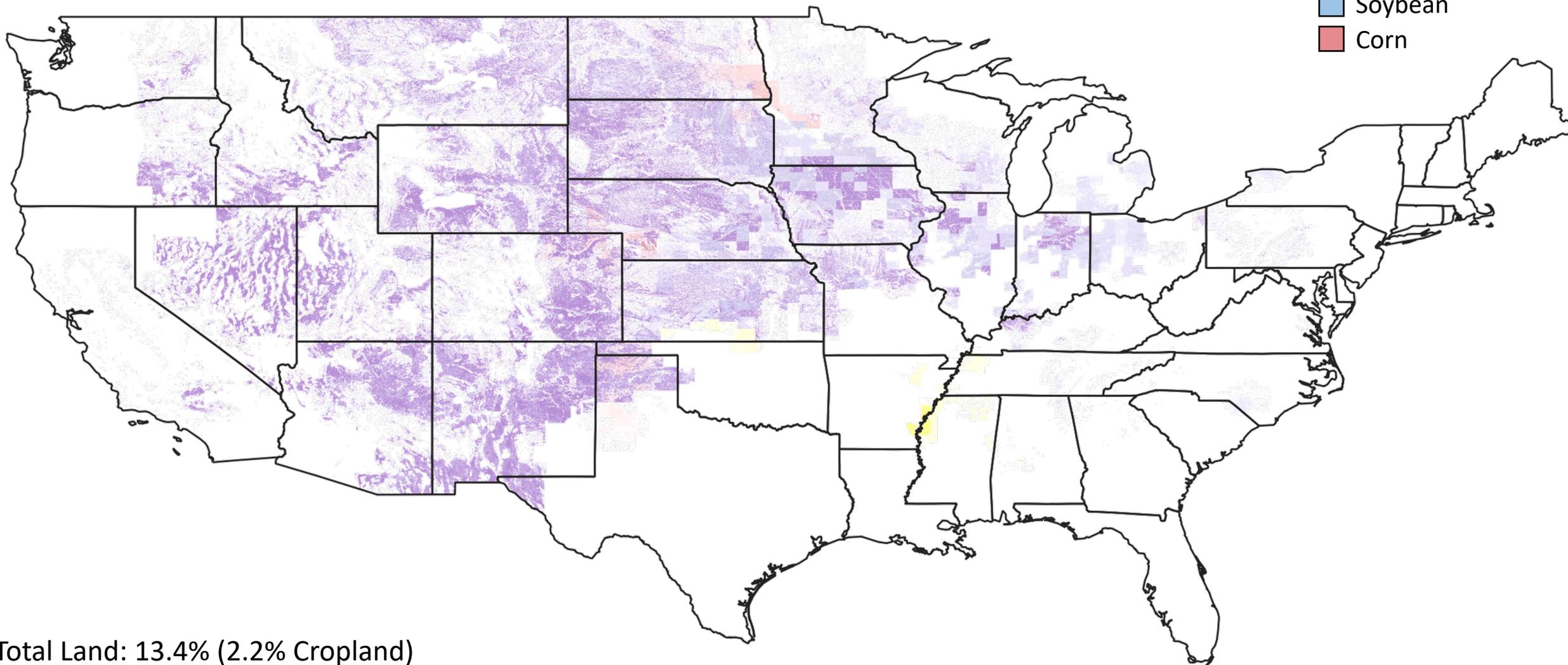
38 gCO₂/gal

\$4.80/gal

159.6 gal/acre

MINIMIZE GHGs (GREEN HOUSE GAS EMISSIONS)

- Algae
- Miscanthus
- Poplar
- Upland Switchgrass
- Lowland Switchgrass
- Soybean
- Corn



Total Land: 13.4% (2.2% Cropland)

39.72 bn gallons

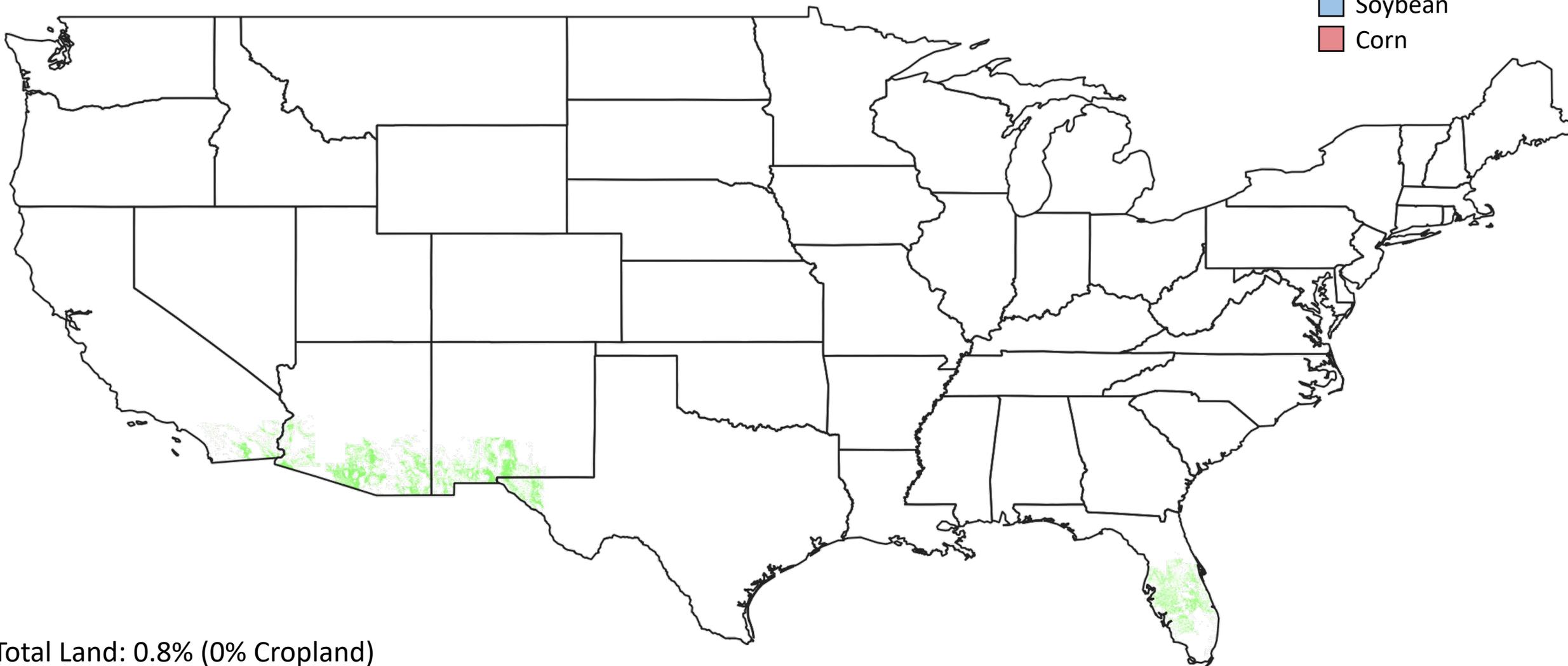
8,081 gCO₂/gal

\$8.53/gal

2,748 gal/acre

MINIMIZE LAND AREA

- Algae
- Miscanthus
- Poplar
- Upland Switchgrass
- Lowland Switchgrass
- Soybean
- Corn

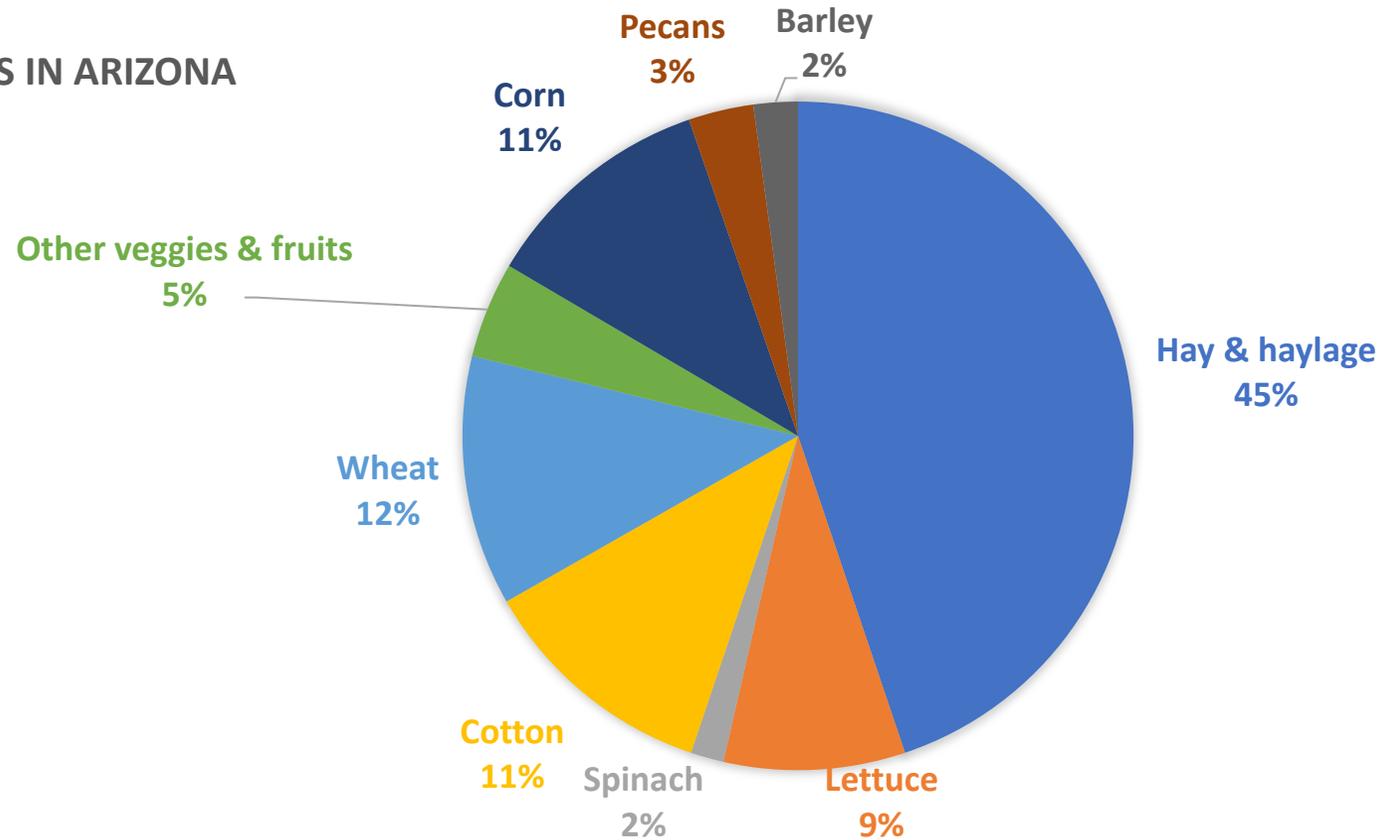


Total Land: 0.8% (0% Cropland)



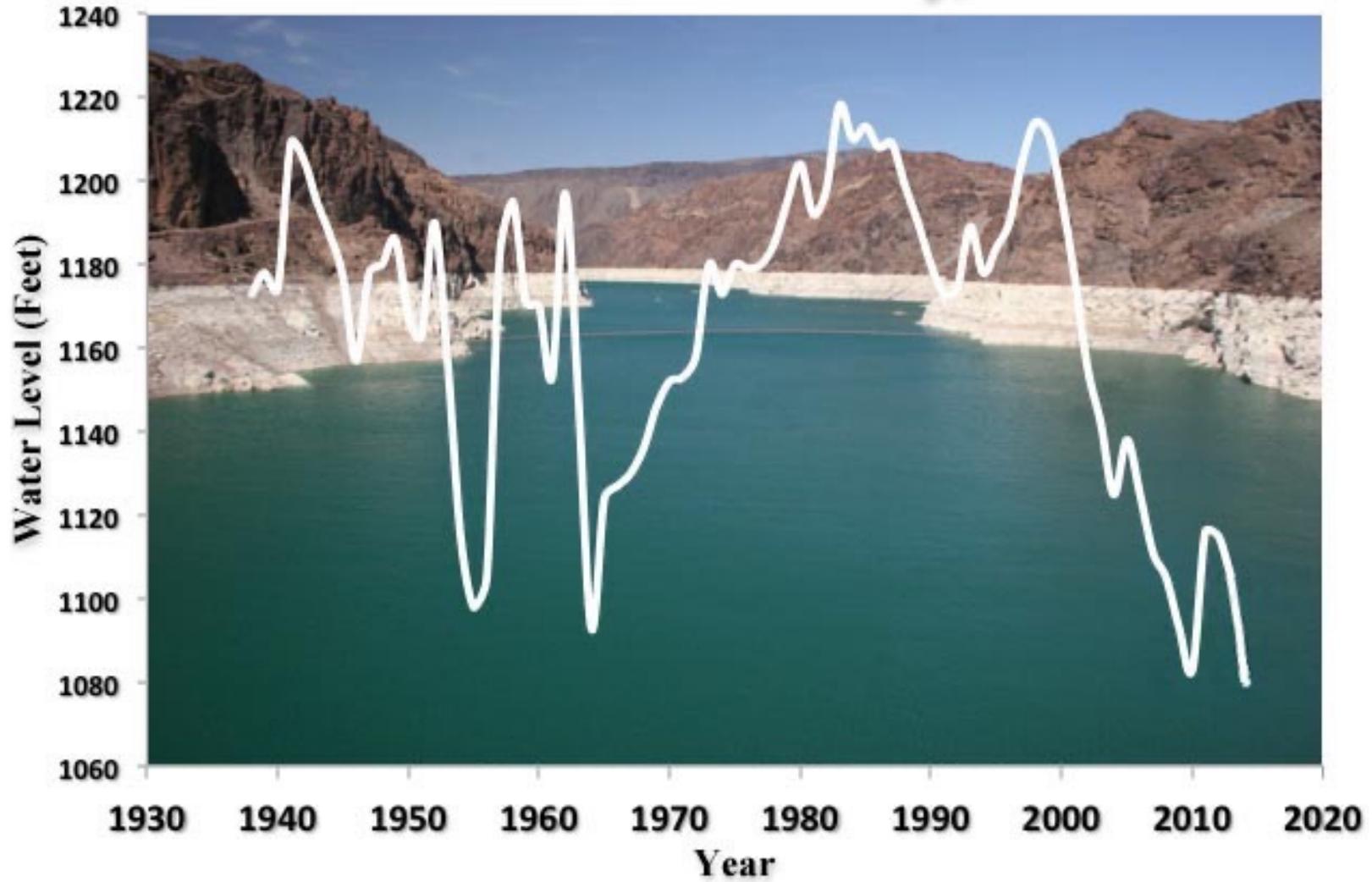
NASS USDA Crop Harvest Data 2022

722,600 ACRES IN ARIZONA



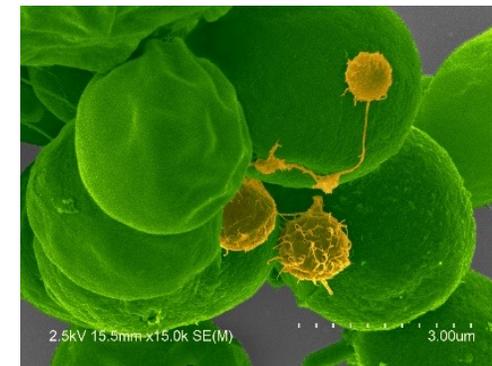
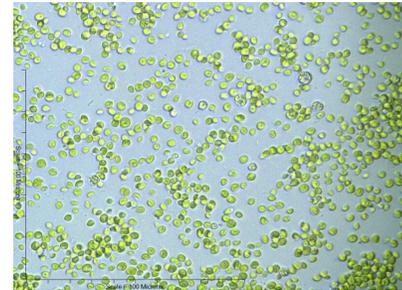


Lake Mead Water Level in July, 1938 - 2014



Cultivation Advances – Open Ponds

- Crop Rotation Strategies –
 - RAFT Project - *Chlorella* and *Monorophidium*
 - AzCATI and Discover – *Picochlorum* and *Monorophidium*
- Pest Management

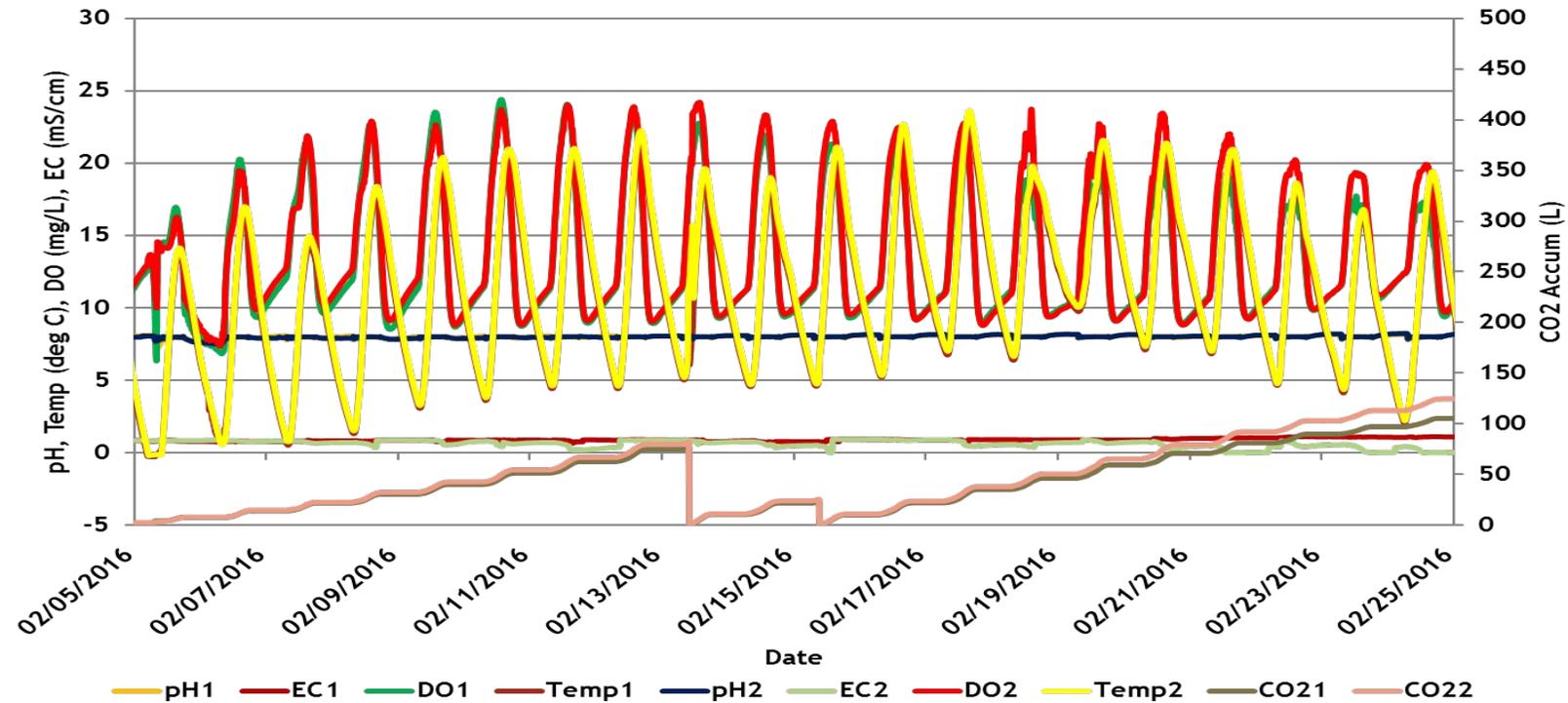




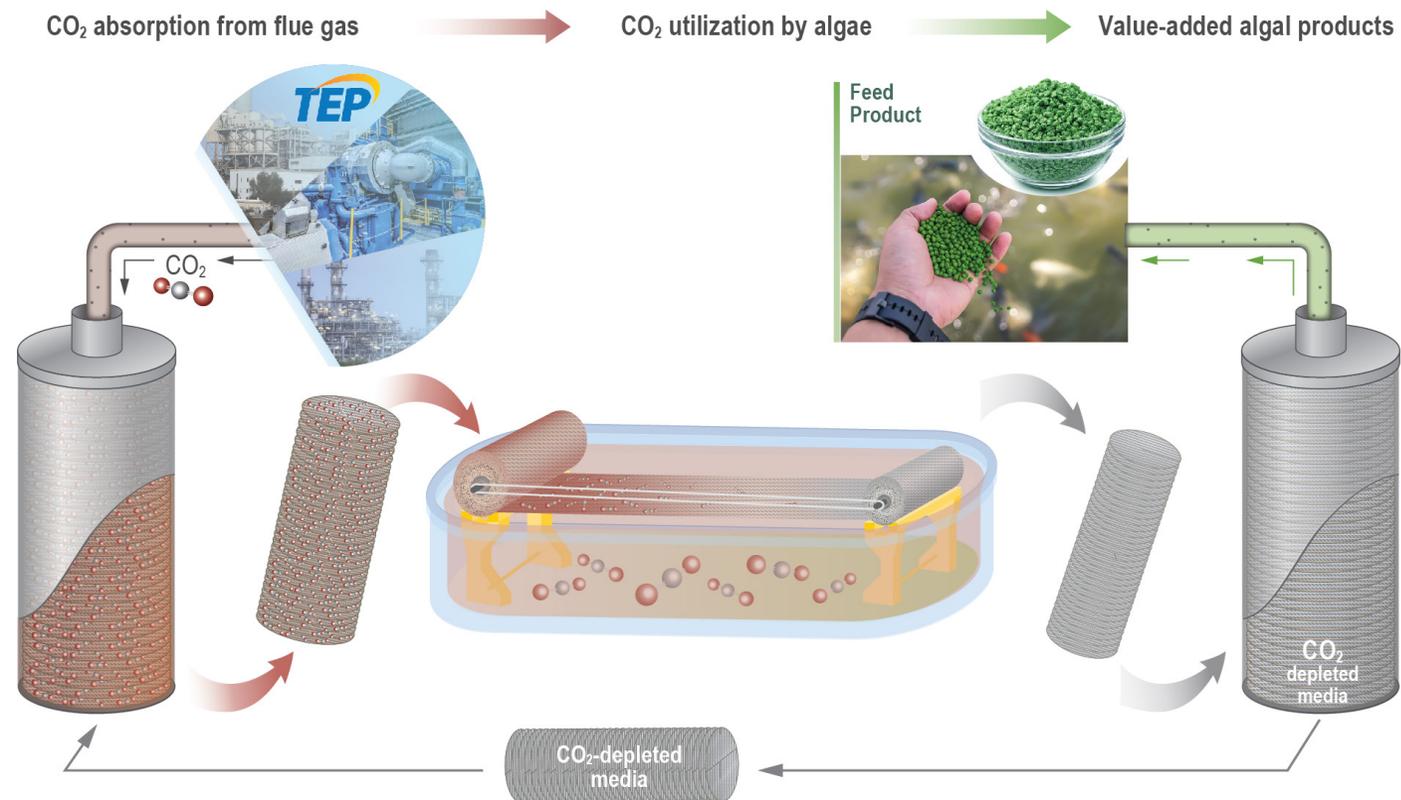
Work still to be done

- Carbon Capture
 - Mass balances – through entire process
 - Flue gas
- Process Control
- Wastewater

Continuous data. *Monoraphidium Minutum*
PW1 and PW2 (6 inch culture depth)



Next steps



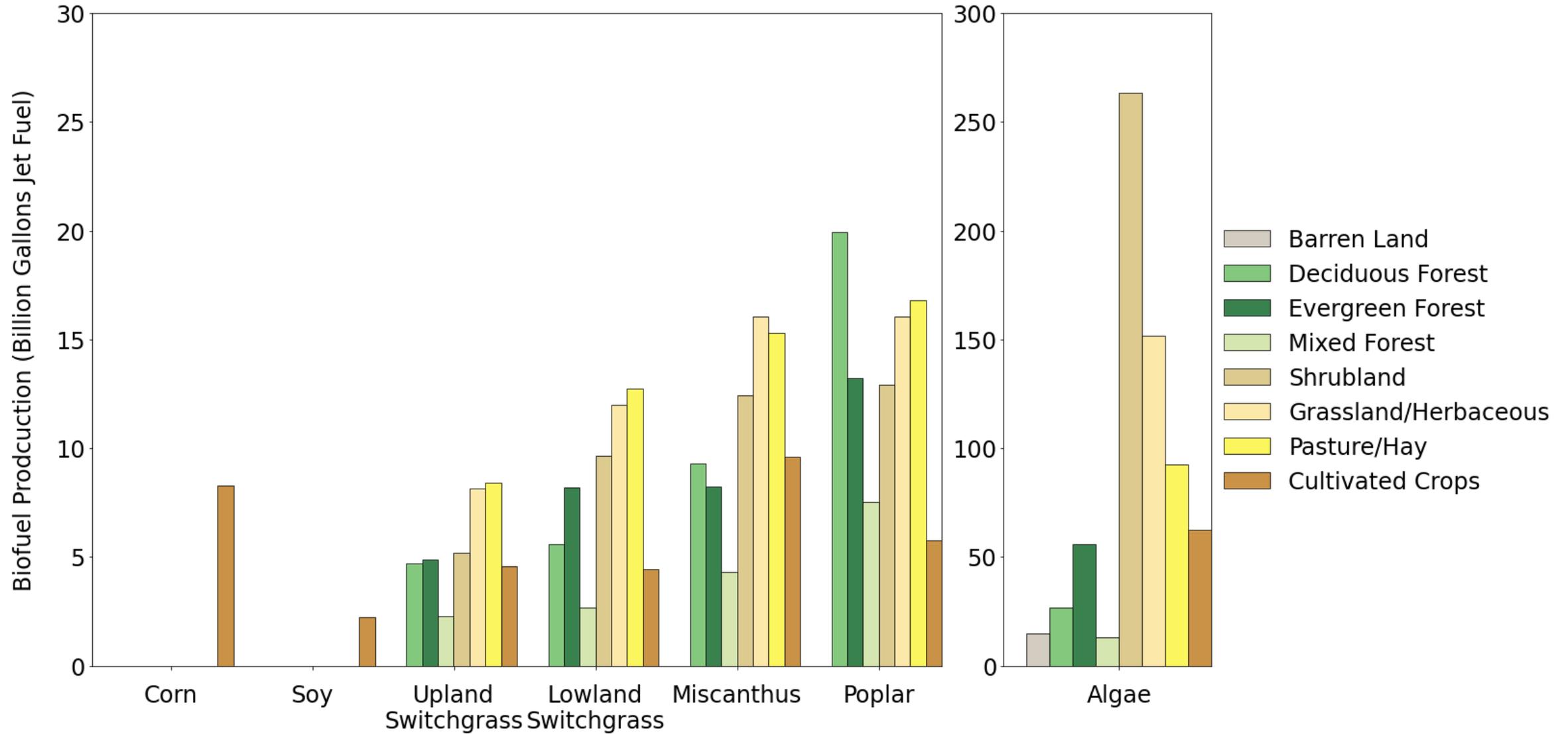
ALBUS

Southwest Technologies LLC; Lawrence Livermore National Laboratory (LLNL); University of Arizona (UA); Sandia National Laboratories (SNL); Tucson Electric Power (TEP) Company

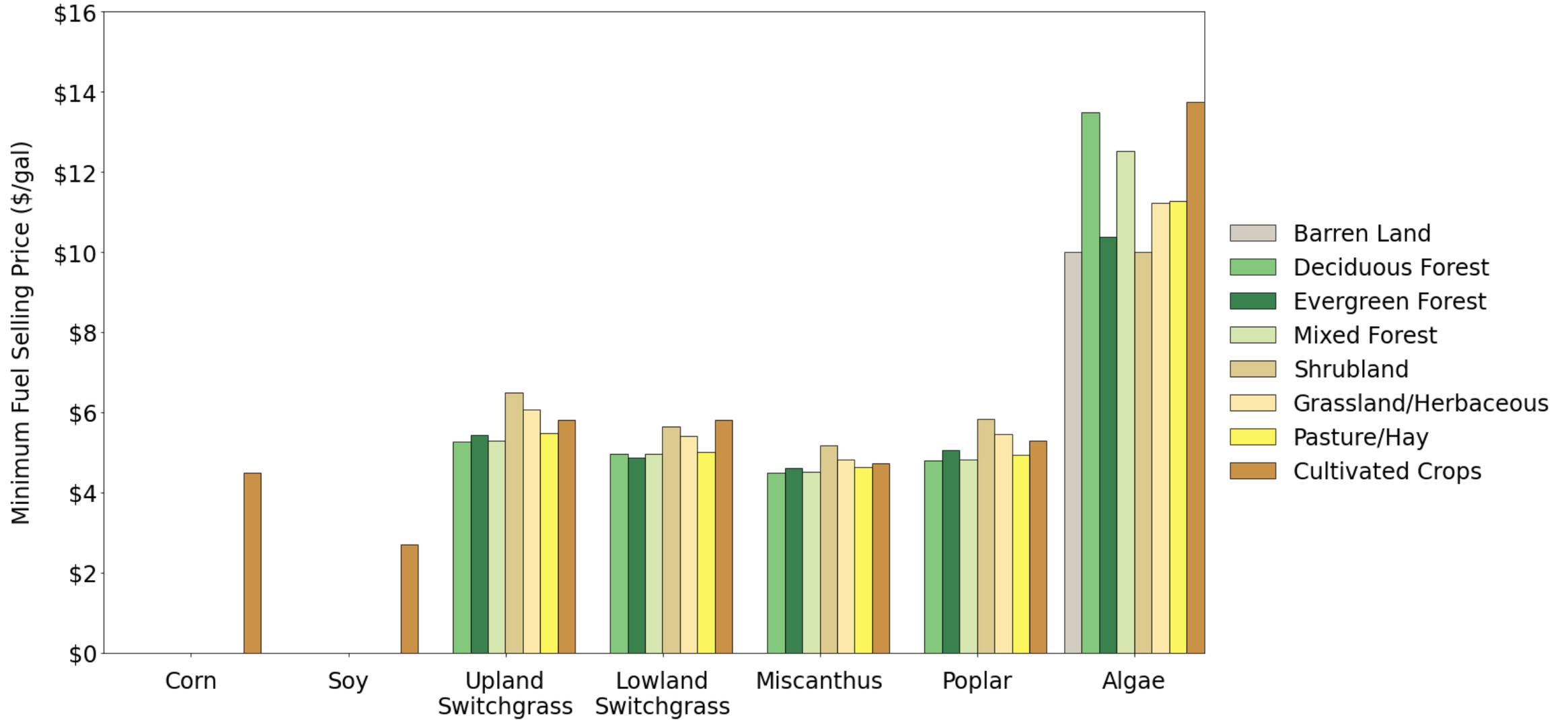


Back Up

NATIONALLY AGGREGATED RESULTS (PRODUCTION)



NATIONALLY AGGREGATED RESULTS (ECONOMICS)



NATIONALLY AGGREGATED RESULTS (EMISSIONS)

